

TURNBERRY TOWER ARLINGTON

ARLINGTON, VIRGINIA



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Construction Management

Dr. David Riley

October 24, 2008

Technical Assignment 2

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Executive Summary

This technical assignment has been put together to further familiarize the reader with the Turnberry Tower Arlington Project in Arlington, Virginia. In this report you will find a detailed project schedule, different site plans used during the construction process, a detailed structural systems estimate for the post-tension concrete structure, and the general conditions estimate used to construct the building. Lastly, a summary from the 2008 PACE Conference is given.

Excavation of the site started on July 2nd, 2007 and the project has a substantial completion date set for August 30th, 2009. Counting preconstruction services, the project will take a little over 3 years to complete. The project's schedule was put together utilizing a Short Interval Production Schedule (SIPS) for the construction of the tower levels. With the highly repetitive amount of work from level to level, this is a great example of when SIPS can be used to make a job run more efficiently.

This project had 3 different phases of construction which led to the need for 3 different site plans. During excavation most of the equipment was located down in the hole for digging purposes. The limited space around the hole was left open or used for the storage of materials. The next phase consisted of the erection of the garage, which, logistically, was the most complicated phase. The garage footprint comprises most of the site. This left little space for site offices and material and equipment storage. With limited space in a downtown environment, careful planning was needed to ensure this construction went smoothly. The last phase to be completed is the tower erection. This occurs after the completion of the garage, so the garage is used as storage and office space for the subcontractors. The SIPS schedule also creates lead time for the erection of the post-tension decks and the rough-in on the floors. That gives the subcontractors the ability to stock their materials on the floor where it is needed prior to beginning their activities.

A detailed structural systems estimate was created to see how much the post-tension concrete structural system will cost for this project. All of the materials were quantified in amounts and given a unit price. This price was then combined with the average cost of labor and equipment. The total cost for the structural system was found to be \$20.6 million which equates to \$27.55 per square foot.

A general conditions estimate was created based on numbers and items obtained from the general contractor. From that percentages and cost per units were extrapolated. Some of the items that made up the estimate included staff, site work, temporary utilities, site office, and insurance. The total cost for general conditions for this project are \$13.5 million.

On October 16th, 2008, the PACE Conference took place at Penn State University. Different topics discussed included the creation a mentoring program, energy and the environment, and a group discussion with an industry panel and a student panel. Parts from each discussion will aid in the creation of a thesis topic including the rising price of materials and the potential shift in companies to different types of work all because of the economic crisis that is occurring.

I. Detailed Project Schedule

The schedule that has been created is based on the phases of construction for Turnberry Tower Arlington. The first construction phase includes the erection of the 6 story underground parking garage and the second construction phase includes the erection of the 26 story residential tower. The detailed schedule can be found in **Appendix A**. Below in *Table I.1* you can find the abridged version of the detailed schedule which includes only the summary activities.

ID	Task Name	Duration	Start	Finish	1st Half				1st Half				1st Half				1st Half			
					1st Quarter	3rd Quarter	1st Quarter	3rd Quarter	1st Quarter	3rd Quarter	1st Quarter	3rd Quarter	1st Quarter	3rd Quarter	1st Quarter	3rd Quarter				
1	Preconstruction	218 days	Mon 1/30/06	Thu 11/30/06																
7	Soldier Piles and Underpinning	130 days	Tue 1/2/07	Mon 7/2/07																
8	Sheeting & Bracing	122 days	Tue 1/16/07	Wed 7/4/07																
15	Structure Excavation	136 days	Fri 1/12/07	Fri 7/20/07																
16	Building Structure	354 days	Wed 8/1/07	Mon 12/8/08																
50	Building Rough-in	145 days	Thu 2/14/08	Wed 9/3/08																
57	Condo Rough-in (MEP & Framing)	169 days	Thu 6/12/08	Tue 2/3/09																
82	Window Wall / Curtain Wall	143 days	Mon 4/21/08	Wed 11/5/08																
107	Drywall & Tape	136 days	Mon 7/7/08	Mon 1/12/09																
132	Building Finishes	315 days	Thu 3/20/08	Wed 6/3/09																
164	Condo Finishes (Kitchen & Bathrooms)	155 days	Mon 8/11/08	Fri 3/13/09																
189	Elevators	247 days	Thu 9/18/08	Fri 8/28/09																
193	General Items	323 days	Thu 2/14/08	Mon 5/11/09																
199	Substantial Completion	0 days	Sun 8/30/09	Sun 8/30/09																

Table I.1 – Abridged Detailed Schedule

From the above schedule, some of the key completion dates for Turnberry Tower Arlington include:

Structure Excavation	July 2 nd , 2007
Building Structure Erection	December 8 th , 2008
Condo Rough-in (MEP & Framing)	February 3 rd , 2009
Window Wall / Curtain Wall	November 5 th , 2008
Building Finishes	June 3 rd , 2009
Elevators	August 28 th , 2009
Substantial Completion	August 30 th , 2009

The schedule that has been created shows the Short Interval Production Schedule (SIPS) that is being used on this project. Building structure erection, rough-in, window wall / curtain wall, drywall, and finishes are broken down according to each level. Both the garage and the tower levels were grouped together where the same type of work would be taking place (concrete placement) and separated where different work would be occurring (different types of finishing). A copy of the SIPS being used on this job that was utilized to create the detailed schedule can be found in **Appendix B**. Durations and start dates for the activities in the detailed schedule were obtained from the general contractor.

II. Site Layout Planning

During construction of Turnberry Tower Arlington, three different site plans were utilized to help maximize efficiency of construction. The three different phases included excavation, garage erection, and tower erection. A copy of the utility site plan can be found in **Appendix C**.

Excavation

This phase of the project provides the least cluttered site plan. There is 1 equipment trailer on site along with 2 dumpsters (one for concrete and one for garbage for LEED points), toilets, and material storage. The material storage on the west side of the site is for tie-back materials. During this phase the temporary electric shed and covered walkways that are to be used for the whole project were constructed. The access ramp for excavation trucks and equipment is off of Ft. Myer Drive on the east side of the site. See page 6 for a copy of the Excavation Site Plan. *Figure II.1* shows a view of the site looking northeast from Key Boulevard.



Figure II.1 – Picture from Key Blvd.

Garage Erection

This phase of the project was logistically the toughest because of the limited space in a downtown environment. The site was mainly used for construction as you can see from the site plan on page 7. The garage footprint takes up most of the site which made it difficult to have on site job offices, material storage, dumpsters, and worker access to the pit. To ease this congestion, the general contractor along with members of the project team, rented out space in an adjacent office building for the excavation and garage erection phases. Careful planning was needed to erect the tower cranes with all of the needed materials already on site and the covered walkway already being constructed. Concrete deliveries were taken from both Ft. Myer Drive and Nash Street. Dumpsters were emptied from the site fence on the corner of Key Boulevard and Nash Street.

Tower Erection

This phase proved to be the easiest with site logistics planning as you can from the Tower Erection Site Plan on page 8. You can see that the footprint of the tower is significantly smaller than that of the parking garage. Also, with the parking garage finished, space in the garage was used as the site offices for the subcontractors and the general contractor. This helped to free up the rest of the site so it could be used for material staging areas. Figure II.II shows the amount of free space in the lobby level for storage.

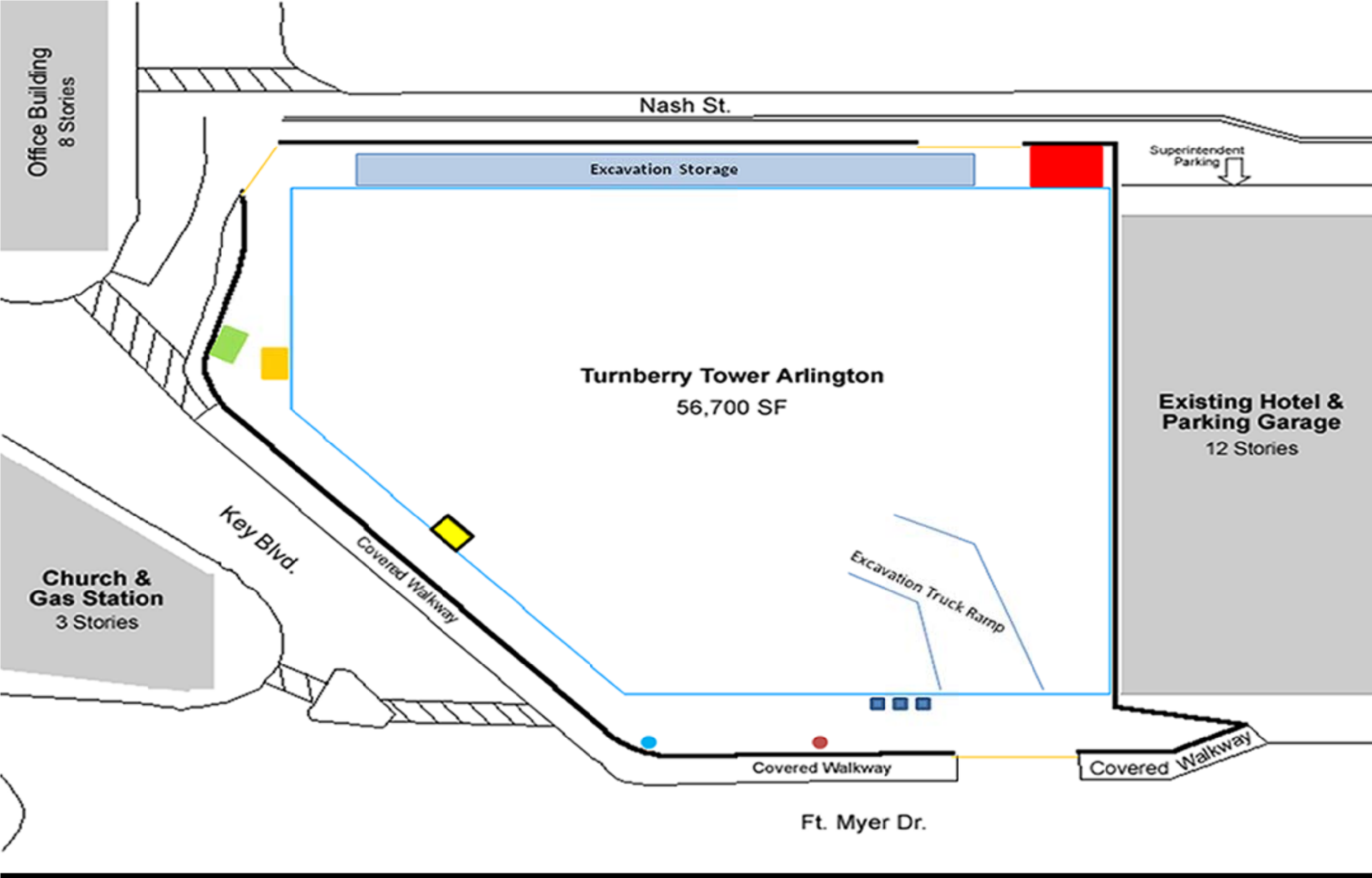
The parking levels were used as storage areas including for the nearly 2 miles of elevator rail that will be installed in the building. Toilets are located on the lobby level near the entrance to the parking garage. The trash chute is on the west side of the site and is located where the trash removal trucks will have easy access to pick up the 30 yard dumpsters via the site access fence. This west site access will also be used for unloading deliveries. This access is the reason that the loading dock and the material hoists are located where they are on the northwest side of the project. This area is big enough that an 18 wheeled tractor trailer is able to unload its' cargo.

The biggest change from the garage erection to the tower erection is the removal of tower crane 2 which frees up most of the east side of the site. It is important to notice that tower crane 1 does not reach the far west side of the building footprint. The only section that the crane cannot reach is a 3 story clock tower. The crane is not needed for its construction, which is being done by the miscellaneous metal subcontractor.



Figure II.II – Lobby Level during Tower Erection

**Turnberry Tower Arlington
Site Plan - Excavation Phase**



Revisions

Date	No.	Description

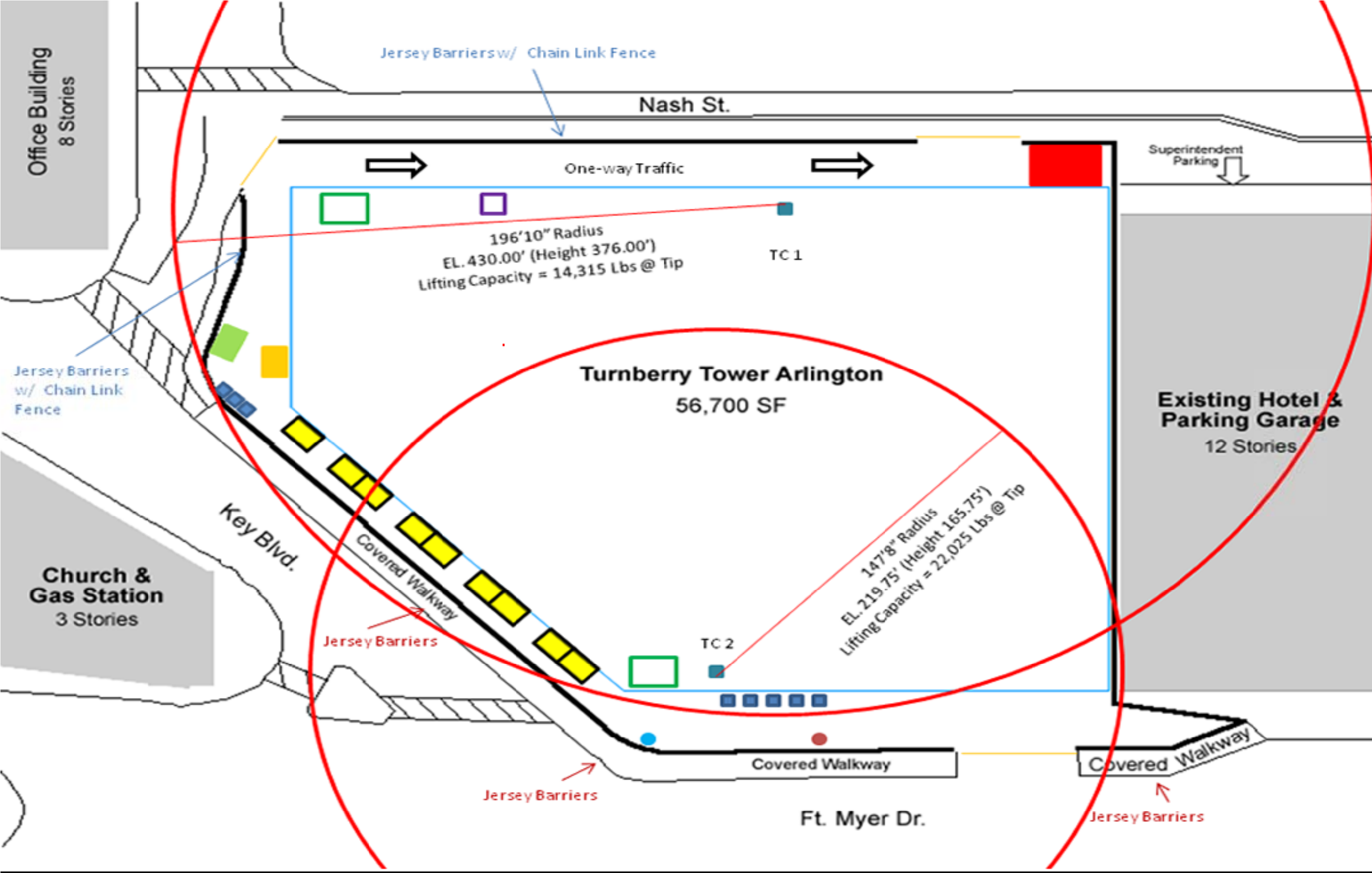
Seal

Drawn by: Larry Warner
Date: 10/24/2008

- Legend**
- Excavation Boundary
 - Relocated Traffic Light
 - 30 Yard Dumpster
 - Equipment Trailer
 - Site Boundary
 - Fire Hydrant
 - Temp. Electric Shed
 - Concrete Dumpster
 - Site Chain Link Fence
 - Toilet

Direction

**Turnberry Tower Arlington
Site Plan - Garage Erection**



Revisions

Date	No.	Description

Seal

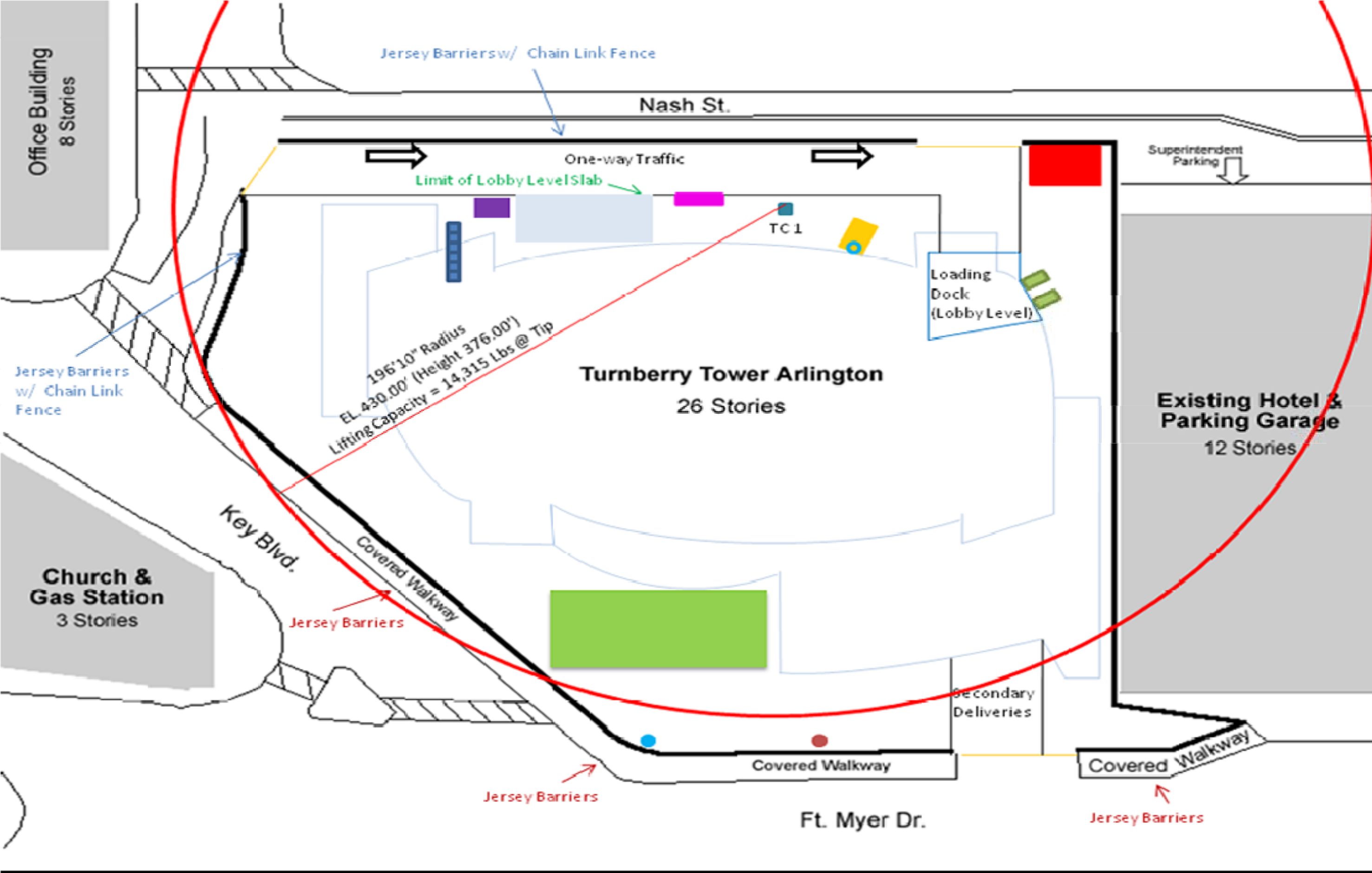
Drawn by: Larry Warner
Date: 10/24/2008

Legend

Garage Boundary	Relocated Traffic Light	30 Yard Dumpster	Temp. Trailer / Office
Site Boundary	Fire Hydrant	Temp. Electric Shed	Concrete Dumpster
Site Chain Link Fence	Toilet	Material Hoist	Stair Tower

Direction

**Turnberry Tower Arlington
Site Plan - Tower Erection**



Revisions

Date	No.	Description

Seal

Drawn by: Larry Warner
Date: 10/24/08

Legend

Building Boundary	Relocated Traffic Light	30 Yard Dumpster	Rebar Laydown Area	Trash Chute
Site Boundary	Fire Hydrant	Temp. Electric Shed	Concrete Dumpster	Equipment Storage
Site Chain Link Fence	Toilet	Concrete Pump & Truck	Material Hoist	

Direction

III. Detailed Structural Systems Estimate

Turnberry Tower Arlington’s primary structural system is post-tension concrete for the tower level and cast in place concrete for the parking levels. A structural system estimate was created from takeoff notes for the entire structural system of the building. Below in *Table III.I through Table III.III* are the results from the estimate. All takeoff notes can be found in **Appendix D**.

Total Material Cost		
Item	Amount	Total Cost
Concrete	37,351 CY	\$4,668,875
Reinforcing Steel	3071 Tons	\$3,071,000
Miscellaneous Items		\$2,481,385
Total		\$10,221,260
Total per CY		\$273.65

Table III.I – Total Material Cost

Average Labor and Equipment			
Description	Labor	Equipment	Unit
Footings	\$54.50	\$0.33	CY
Columns	\$435.00	\$42.50	CY
Slab on Grade	\$55.00	\$0.41	CY
Slabs	\$207.00	\$19.60	CY
Beams	\$490.00	\$48.50	CY
Shear Walls	\$430.00	\$42.50	CY
Curbs, Pads, Toppings	\$129.00	\$1.78	CY
Average per CY	\$257.21	\$22.23	CY

Table III.II – Average Labor and Equipment Costs

Construction Cost of Concrete System for Turnberry Tower Arlington						
Description	Qty	Unit	Material	Labor	Equipment	Total Cost
Cast In Place Concrete including placing and stripping formwork, placing rebar, placing concrete, and finishing concrete	37351	CY	\$273.65	\$257.21	\$22.23	\$20,658,837
					TOTAL	\$27.55 per SF

Table III.III – Construction Cost of Structural System

R.S. Means 2008 Building Construction was used to find the average price of labor and materials that were needed to create this construction estimate. Prices for concrete per cubic yard, rebar per ton, and PT cable cost per pound were obtained directly from the subcontractor. Prices that were given include:

- Concrete = \$125 / cubic yard
- Rebar = \$1000 / ton
- PT Cable = \$1.15 / pound

These numbers were used with the takeoff values to obtain the material cost for the structural system which totaled \$10,221,260. When this number is divided by the number of cubic yards of concrete for this project the total is \$273.65 per cubic yard. This number was added to the average cost of labor (\$257.21 per cubic yard) and equipment (\$22.23 per cubic yard) and the total cost of \$20,658,837 was obtained for the construction of the concrete structural system. This number, when divided by the projects 750,000 square feet, yields \$27.55 per square foot (as seen in *Table III.III*).

The price of \$27.55 is a bit high for concrete construction. Normal construction averages \$25 per square foot. Some of the reasons that this estimate may be high include:

1. Rise in prices for steel and rebar
2. Transportation costs to get the material to site
3. Cost of the automatic climbing formwork and flying formwork to gain time on the schedule
4. Post-tension steel cables
5. Much larger waste factor was calculated than was necessary

Figure III.I shows a typical tower level with rebar cages for shear walls and columns, part of a concrete deck poured, and exposed PT cables laid out and ready for a concrete pour. *Figure III.II* shows the use of the Automatic Climbing System (ACS) for the core of the building.

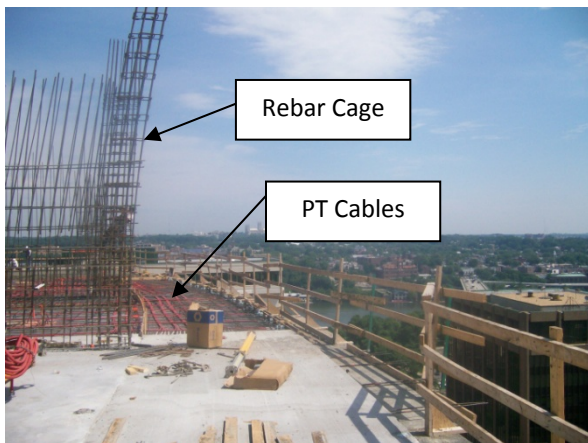


Figure III.I - Working Deck



Figure III.II – ACS Formwork for Core

V. PACE Seminar 2008 – Critical Industry Issues

Session 1 – Mentoring

During this session students and industry members discussed what would be the best way to set up a mentoring program for the Architectural Engineering Department. I was able to work with Mark Konchar from Balfour Beatty Construction. During our discussion the group agreed some of the necessities for this program would include having this program separate for classes and not including it as part of a grade for the student. It was discussed that it would be important for the mentor be unbiased and not use this program as a recruiting tool.

I was surprised from the number of industry members who agreed that this program should stay separate from a recruiting technique. All agreed that if this became a recruiting type of program then it would not benefit the students and the program might not last. A majority of the students want to see the program create relationships that do not incorporate having to get an internship or a job. If this program is done right, it could benefit both parties. The students would have help with career decisions and someone they can look up to, and the mentors will have a direct link to the Architectural Engineering Department which will help them stay abreast on current issues and research.

Session 2 – Energy and the Environment

This session was the most informative of the day. Topics that were discussed included the state of the economy and how that impacts different sectors of construction. Also discussed were employment and benefits in different companies and how sustainable construction can effect construction overall when money is tight. The general opinion of industry members is for students to find a company that would like to make an investment on its' employees. You also should look long term and someone is who trying to grow at a constant rate.

Some of the surprising discussions came when industry members were talking about how some developers are enjoying the tough times that our economy is going through. Although there much more preconstruction going during times like these, there are developers buying properties at a very cheap price. It is also a good time for developers to pick up "salvage projects" at a reduced price. Some contractors enjoy projects like this because the bonding company is responsible for paying them and not the owner who may become bankrupt at a time like this.

Session 3 – Industry Panel

Six members from the industry sat up on a panel and answered questions from students. Questions ranged from asking about different construction techniques, technology and how it will be implemented in the construction field, and how important new hires are to companies.

One answer that surprised me the most pertained to new hires and their importance to a company. It was said that some companies look to their new staff to become the experts in new types of construction techniques and processes. Most of these candidates have just finished college and are used to working with newer programs and computers. This will enable them to teach this technology to others in the company as well.

Session 4 – Student Panel

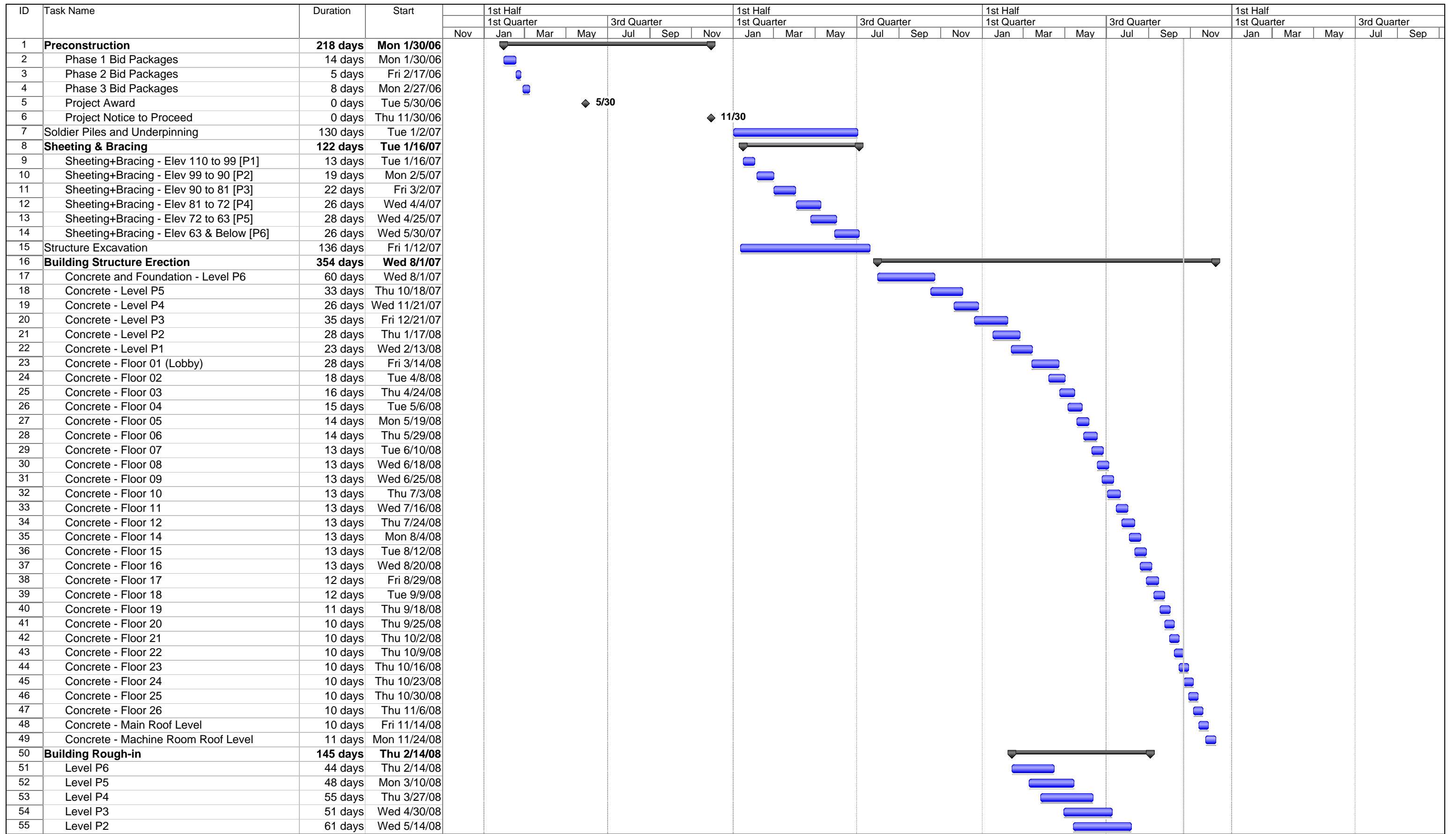
For this exercise I was fortunate enough to be able to sit on this panel. This discussion was about distractions and how they help or hurt our productivity and ability to work. Most of the questions asked were very good and made all of us on the panel think hard and relate the answers to past experiences.

The one thing that shocked me was how different everyone is that was on the panel with extracurricular activities that keep us all busy. When we are all in class and working on school work, we seem to have the same things in common. That is why many people, especially in the construction management option, seem to be close friends. When you put that aside, it seemed that everyone was almost completely different with the activities we all do. Those differences coupled with our values will dictate what path we take in our careers.

Issues Pertaining To My Project

Some of the issues that will help my project will be the prefabrication of different materials and how that can help the overall cost and schedule. Most MEP units do come partially assembled but it would be interesting to see more common items assembled before they were delivered. Another issue that can be looked at closely is technology from other countries. For some of the systems in my building including MEP, it would interesting to see if there are other systems out there that would be more efficient and save money than the ones currently being used.

Appendix A – Detailed Project Schedule












Project: Project1.mpp
Date: Wed 10/22/08

Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			

ID	Task Name	Duration	Start	1st Half									1st Half									1st Half								
				1st Quarter			3rd Quarter			1st Quarter			3rd Quarter			1st Quarter			3rd Quarter			1st Quarter			3rd Quarter					
				Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep			
56	Level P1	73 days	Mon 5/26/08																											
57	Condo Rough-in (MEP & Framing)	169 days	Thu 6/12/08																											
58	Floor 02	32 days	Thu 6/12/08																											
59	Floor 03	32 days	Mon 6/23/08																											
60	Floor 04	32 days	Tue 7/1/08																											
61	Floor 05	32 days	Thu 7/10/08																											
62	Floor 06	32 days	Wed 7/16/08																											
63	Floor 07	32 days	Mon 7/28/08																											
64	Floor 08	32 days	Wed 8/6/08																											
65	Floor 09	32 days	Mon 8/18/08																											
66	Floor 10	32 days	Tue 8/26/08																											
67	Floor 11	32 days	Thu 9/4/08																											
68	Floor 12	32 days	Fri 9/12/08																											
69	Floor 14	32 days	Fri 9/19/08																											
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Project: Project1.mpp
Date: Wed 10/22/08

Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			

ID	Task Name	Duration	Start	1st Half									1st Half									1st Half								
				1st Quarter				3rd Quarter					1st Quarter				3rd Quarter					1st Quarter				3rd Quarter				
				Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep			
166	Floor 03	35 days	Mon 8/18/08																											
167	Floor 04	35 days	Mon 8/25/08																											
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194	Building Water-tight	30 days	Tue 1/13/09																											
195	Building Masonry	124 days	Thu 2/14/08																											
196	Drywall (Lobby & Public Areas)	178 days	Tue 6/3/08																											
197	Painting (Public Areas)	154 days	Wed 10/8/08																											
198	Tile Walls & Floors	126 days	Mon 10/20/08																											
199	Substantial Completion	0 days	Sun 8/30/09																											

Project: Project1.mpp
Date: Wed 10/22/08

Task: Progress
Split: Milestone

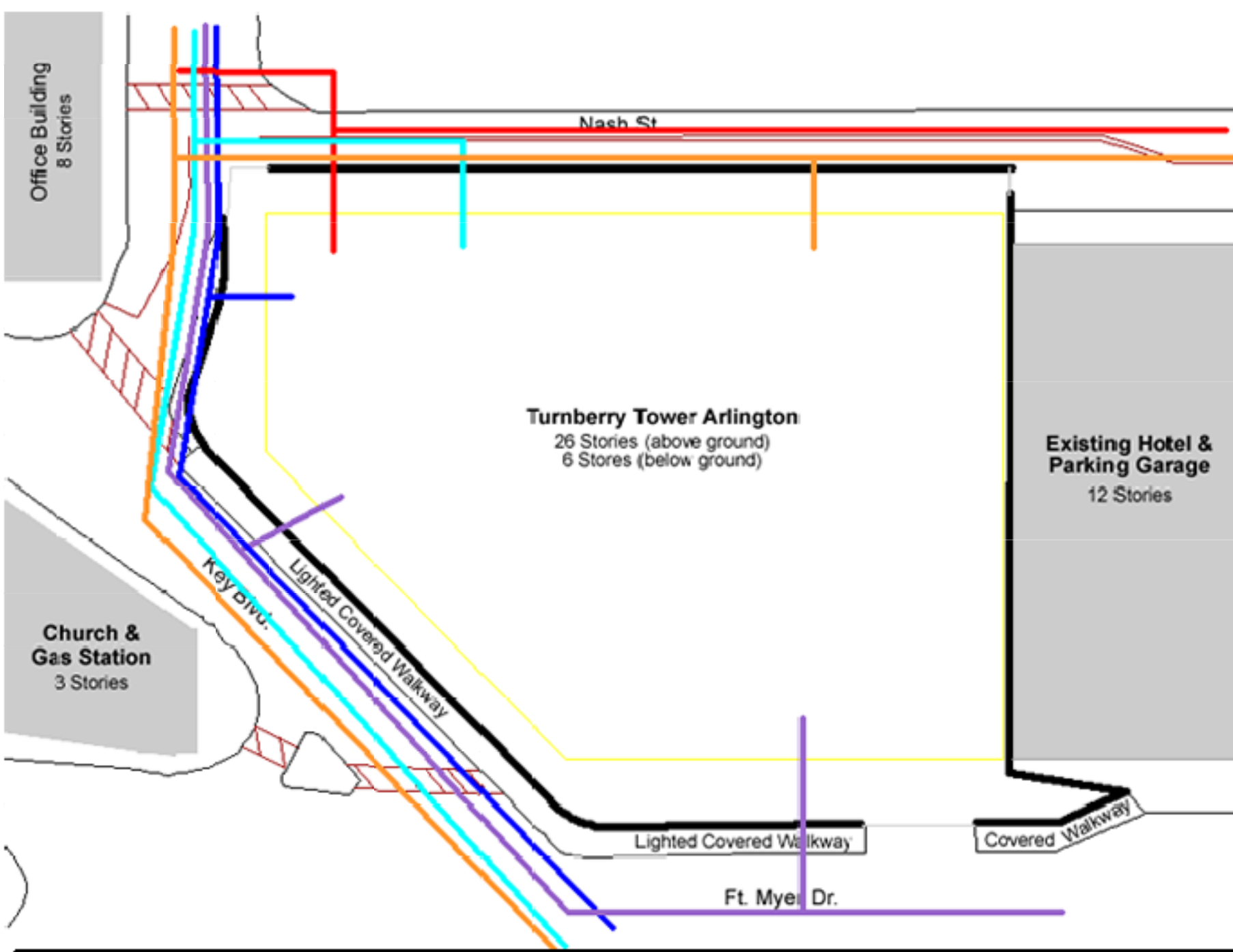
Summary: External Tasks: Deadline:

Project Summary: External Milestone:

Appendix B – SIPS

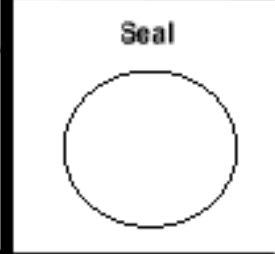
Appendix C – Utility Site Plan

Turnberry Tower Arlington
Site Utility Plan



Revisions

Date	No.	Description



Drawn by: Larry Warner
Date: 9/29/2008

Legend

- Telecommunications
- Water
- Sewage / Storm Drain
- Electric
- Gas

Direction



Appendix D – Detailed Structural Estimate Takeoff Notes and Charts

COLUMN REBAR					
Column Number	# of Bars	Bar Number	LBS / FT	Total Height (ft)	Total LBS
101	10	9	3.4	330.83	11248
102	10	9	3.4	330.83	11248
103	10	9	3.4	124.75	4242
	10	11	5.313	60.5	3214
	14	11	5.313	50.41	3750
	22	11	5.313	20.17	2358
	26	11	5.313	75	10360
104	16	9	3.4	312.83	17018
	16	11	5.313	9	765
	20	11	5.313	9	956
105	8	10	4.303	330.83	11388
106	8	10	4.303	124.75	4294
	12	11	5.313	50.42	3215
	20	11	5.313	60.49	6428
	24	11	5.313	20.17	2572
	22	11	5.313	57	6663
	30	11	5.313	18	2869
107	12	9	3.4	255.83	10438
	12	11	5.313	57	3634
	20	11	5.313	18	1913
108	10	9	3.4	255.83	8698
	10	10	4.303	75	3227
109	8	9	3.4	260.37	7082
	8	10	4.303	75	2582
110	8	9	3.4	260.37	7082
	8	10	4.303	75	2582
111	12	9	3.4	134.83	5501
	12	11	5.313	50.42	3215
	16	11	5.313	40.33	3428
	26	11	5.313	87.25	12053
	36	11	5.313	18	3443
112	12	9	3.4	134.83	5501
	12	11	5.313	50.42	3215
	16	11	5.313	40.33	3428
	26	11	5.313	87.25	12053
	36	11	5.313	18	3443
113	8	9	3.4	260.37	7082
	8	10	4.303	75	2582
114	8	9	3.4	260.37	7082

	8	10	4.303	75	2582
115	12	9	3.4	255.83	10438
	12	11	5.313	57	3634
	20	11	5.313	18	1913
116	8	10	4.303	124.75	4294
	12	11	5.313	50.42	3215
	20	11	5.313	60.49	6428
	24	11	5.313	20.17	2572
	22	11	5.313	57	6663
	30	11	5.313	18	2869
117	8	10	4.303	330.83	11388
118	10	9	3.4	124.75	4242
	10	11	5.313	60.5	3214
	14	11	5.313	50.41	3750
	22	11	5.313	20.17	2358
	26	11	5.313	75	10360
119	10	9	3.4	285.83	9718
	10	11	5.313	45	2391
120	10	9	3.4	285.83	9718
	10	11	5.313	45	2391
				Subtotal	325987
201	12	11	5.313	75	4782
202	12	11	5.313	75	4782
203	12	11	5.313	75	4782
204	20	11	5.313	18.5	1966
	22	11	5.313	56.5	6604
205	20	11	5.313	18.5	1966
	22	11	5.313	56.5	6604
206	20	11	5.313	18.5	1966
	22	11	5.313	56.5	6604
207	20	11	5.313	75	7970
208	8	8	2.67	75	1602
209	8	8	2.67	75	1602
210	8	8	2.67	75	1602
211	8	8	2.67	75	1602
212	8	8	2.67	75	1602
213	8	10	4.303	75	2582
214	8	8	2.67	18.5	395
215	8	8	2.67	18.5	395
				Subtotal	59406

301	10	9	3.4	56.54	1922
302	10	9	3.4	56.54	1922
303	10	9	3.4	56.54	1922
304	6	8	2.67	56.54	906
305	6	8	2.67	56.54	906
306	6	8	2.67	56.54	906
307	6	8	2.67	56.54	906
308	10	9	3.4	56.54	1922
309	10	9	3.4	56.54	1922
310	10	9	3.4	56.54	1922
311	10	9	3.4	56.54	1922
312	6	8	2.67	56.54	906
313	10	9	3.4	56.54	1922
314	8	8	2.67	56.54	1208
315	8	8	2.67	56.54	1208
316	8	8	2.67	56.54	1208
317	8	8	2.67	56.54	1208
318	8	8	2.67	56.54	1208
319	8	8	2.67	56.54	1208
320	8	8	2.67	56.54	1208
321	4	9	3.4	45	612
322	8	8	2.67	56.54	1208
323	8	8	2.67	56.54	1208
324	8	8	2.67	56.54	1208
325	8	8	2.67	56.54	1208
326	8	8	2.67	56.54	1208
327	8	8	2.67	56.54	1208
328	8	8	2.67	56.54	1208
329	8	8	2.67	56.54	1208
330	8	8	2.67	56.54	1208
331	8	8	2.67	56.54	1208
332	8	8	2.67	56.54	1208
333	8	8	2.67	56.54	1208
334	8	8	2.67	56.54	1208
335	8	8	2.67	56.54	1208
336	8	8	2.67	56.54	1208
337	8	8	2.67	20.5	438
338	8	8	2.67	20.5	438
				Subtotal	47965
				Rebar Columns (LBS)	433358
				Waste Factor (5%)	1.05
				TOTAL REBAR FOR COLUMNS (Lbs)	455026
				TOTAL REBAR FOR COLUMNS (Ton)	228

Concrete Slabs				
Level	Area (Ft^2)	Thickness (Ft)	Volume (CF)	Volume (CY)
P-6	40,000	0.67	26800	993
P-5	40,000	0.67	26800	993
P-4	40,000	0.67	26800	993
P-3	40,000	0.67	26800	993
P-2	40,000	0.67	26800	993
P-1	40,000	0.67	26800	993
L	25,000	1	25000	926
2	20,100	0.583	11718.3	434
3	20,100	0.583	11718.3	434
4	20,100	0.583	11718.3	434
5	20,100	0.583	11718.3	434
6	20,100	0.583	11718.3	434
7	20,100	0.583	11718.3	434
8	20,100	0.583	11718.3	434
9	20,100	0.583	11718.3	434
10	20,100	0.583	11718.3	434
11	20,100	0.583	11718.3	434
12	20,100	0.583	11718.3	434
14	20,100	0.583	11718.3	434
15	20,100	0.583	11718.3	434
16	20,100	0.583	11718.3	434
17	20,100	0.583	11718.3	434
18	20,100	0.583	11718.3	434
19	20,100	0.583	11718.3	434
20	20,100	0.583	11718.3	434
21	20,100	0.583	11718.3	434
22	20,100	0.583	11718.3	434
23	20,100	0.583	11718.3	434
24	20,100	0.583	11718.3	434
25	20,100	0.583	11718.3	434
26	20,100	0.583	11718.3	434
MPH	20,100	0.583	11718.3	434
Total (CY)				17732
Waste Factor (5%)				1.05
TOTAL CONCRETE FOR SLABS (CY)				18618

Concrete						
Column Number	Length (ft)	Width (ft)	Depth (ft)	Volume (CF)	Volume (CY)	
101	7	7	3.33	163.33	6	
102	7	7	3.33	163.33	6	
103	8	6	3.33	160	6	
104	10.5	6	3.67	231	9	
105	7	7	3.33	163.33	6	
106	8	8	4.00	256	9	
107	8.5	8.5	5.00	361.25	13	
108	8	6	3.33	160	6	
109	7	7	3.33	163.33	6	
110	7	7	3.33	163.33	6	
111	8	6	3.67	176	7	
112	8.5	8.5	5.00	361.25	13	
113	7	7	3.33	163.33	6	
114	7	7	3.33	163.33	6	
115	8.5	8.5	5.00	361.25	13	
116	8	8	4.00	256	9	
117	8	6	3.33	160	6	
118	8	6	3.33	160	6	
119	10.5	6	3.33	210	8	
120	10.5	6	3.33	210	8	
201	8	8	4.00	256	9	
202	8	8	4.00	256	9	
203	8	8	4.00	256	9	
204	8	8	4.00	256	9	
205	8	8	4.00	256	9	
206	8	8	4.00	256	9	
207	9	7	4.00	252	9	
208	4	4	4.00	64	2	
209	4	4	4.00	64	2	
210	4	4	4.00	64	2	
211	4	4	4.00	64	2	
212	4	4	4.00	64	2	
213	4	4	4.00	64	2	
301	5	5	2.00	50	2	
302	5	5	2.00	50	2	
303	5	5	2.00	50	2	

304	4	4	2.00	32	1
305	4	4	2.00	32	1
306	4	4	2.00	32	1
307	4	4	2.00	32	1
308	6	6	2.83	102	4
309	6	6	2.83	102	4
310	6	6	2.83	102	4
311	6	6	2.83	102	4
312	3	3	2.00	18	1
313	6	6	2.83	102	4
314	4	4	2.00	32	1
315	4	4	2.00	32	1
316	4	4	2.00	32	1
317	4	4	2.00	32	1
318	4	4	2.00	32	1
319	4	4	2.00	32	1
320	4	4	2.00	32	1
321	4	4	2.00	32	1
322	4	4	2.00	32	1
323	4	4	2.00	32	1
324	4	4	2.00	32	1
325	4	4	2.00	32	1
326	4	4	2.00	32	1
Concrete for Columns (CY)					281
Waste Factor (5%)					1.05
TOTAL CONCRETE FOR COLUMNS (CY)					296

Post Tension Tendons				
Floor	Amount of PT (Lbs)	Cost Per Lb	Total Cost	
2	25835	\$1.15	\$29,710	
3	25835	\$1.15	\$29,710	
4	25835	\$1.15	\$29,710	
5	25835	\$1.15	\$29,710	
6	25835	\$1.15	\$29,710	
7	25835	\$1.15	\$29,710	
8	25835	\$1.15	\$29,710	
9	25835	\$1.15	\$29,710	
10	25835	\$1.15	\$29,710	
11	25835	\$1.15	\$29,710	
12	25835	\$1.15	\$29,710	
14	25835	\$1.15	\$29,710	
15	25835	\$1.15	\$29,710	
16	25835	\$1.15	\$29,710	
17	25835	\$1.15	\$29,710	
18	25835	\$1.15	\$29,710	
19	25835	\$1.15	\$29,710	
20	25835	\$1.15	\$29,710	
21	25835	\$1.15	\$29,710	
22	25835	\$1.15	\$29,710	
23	25835	\$1.15	\$29,710	
24	25835	\$1.15	\$29,710	
25	25835	\$1.15	\$29,710	
26	25835	\$1.15	\$29,710	
MPH	6959	\$1.15	\$8,003	
TOTAL	626999		\$721,049	

Reinforcing Steel				
Area	Amount (Ton)	Cost per Ton	Total Cost	
Columns	228	\$1,000	\$228,000	
Shear Walls	1944	\$1,000	\$1,944,000	
Slabs	899	\$1,000	\$899,000	
TOTAL	3071		\$3,071,000	

Miscellaneous Items			
Item	Amount	Cost per	Total Cost
Post Tension Cables	626,999 LBS	\$1.15 / lbs	\$721,049
Grout PT Ends	14,456 EA	\$0.50 EA	\$7,228
WWF 6x6 W1.4/W1.4	19,312 SF	\$18.05 / CSF	\$348,582
WWF 6x6 W2.1/W2.1	53,001 SF	\$26.50 / CSF	\$1,404,527
TOTAL			\$2,481,385

Total Material Cost		
Item	Amount	Total Cost
Concrete	37,351 CY	\$4,668,875
Reinforcing Steel	3071 Tons	\$3,071,000
Miscellaneous Items		\$2,481,385
TOTAL		\$10,221,260
TOTAL PER CY		\$273.65

Average Labor and Equipment			
Description	Labor	Equipment	Unit
Footings	\$54.50	\$0.33	CY
Columns	\$435.00	\$42.50	CY
Slab on Grade	\$55.00	\$0.41	CY
Slabs	\$207.00	\$19.60	CY
Beams	\$490.00	\$48.50	CY
Shear Walls	\$430.00	\$42.50	CY
Curbs, Pads, Toppings	\$129.00	\$1.78	CY
Average per CY	\$257.21	\$22.23	CY

Construction Cost of Concrete System for Turnberry Tower Arlington						
Description	Qty	Unit	Material	Labor	Equipment	Total Cost
Cast In Place Concrete including placing and stripping formwork, placing rebar, placing concrete, and finishing concrete	37351	CY	\$273.65	\$257.21	\$22.23	\$20,658,837
			TOTAL	\$27.55	per SF	

Appendix E – General Conditions Estimate

General Conditions Estimate					
Item	Price	% of GC	Units	Cost Per Unit	Cost Per Month
Staff					
Project Managers	\$2,500,000	18.54%	3	\$833,333	\$65,789
Superintendents	\$1,300,000	9.64%	3	\$433,333	\$34,211
Safety Man	\$379,000	2.81%	1	\$379,000	\$9,974
Accountant	\$250,000	1.85%	1	\$250,000	\$6,579
Secretary	\$455,000	3.37%	1	\$455,000	\$11,974
Purchase Agent	\$225,000	1.67%			\$5,921
Scheduler	\$113,000	0.84%	1	\$113,000	\$2,974
Laborers	\$350,000	2.60%			\$9,211
Carpenters	\$95,000	0.70%			\$2,500
Safety Labor	\$31,000	0.23%			\$816
Elevator / Hoist Operations	\$183,000	1.36%	2	\$91,500	\$4,816
Total	\$5,881,000	43.62%			\$154,763
Site Work					
Pre-Survey	\$22,000	0.16%	1	\$22,000	\$579
Surveys	\$175,000	1.30%	1	\$175,000	\$4,605
Permits	\$379,000	2.81%	13	\$29,154	\$9,974
Progress Photos / Webcam	\$17,000	0.13%	1	\$17,000	\$447
Dewatering	\$17,000	0.13%			\$447
Exterior Cleaning	\$94,000	0.70%	1	\$94,000	\$2,474
Final Clean	\$120,000	0.89%	1	\$120,000	\$3,158
Cleanup	\$72,000	0.53%			\$1,895
Access Roads / Parking	\$50,000	0.37%			\$1,316
Miscellaneous Tools	\$10,000	0.07%			\$263
Facility Operation	\$118,000	0.88%			\$3,105
Temporary Toilets	\$119,000	0.88%	20	\$5,950	\$3,132
Total	\$1,193,000	8.85%			\$31,395

Temporary Utilities						
Temporary Power	\$300,000	2.23%	1	\$300,000	\$7,895	
Temporary Heat	\$220,000	1.63%	1	\$220,000	\$5,789	
Telephone / Data / Nextel	\$112,000	0.83%	14	\$8,000	\$2,947	
Temporary Water	\$13,000	0.10%	1	\$13,000	\$342	
Temporary Utilities	\$10,000	0.07%	1	\$10,000	\$263	
Temporary Hoist	\$245,000	1.82%	2	\$122,500	\$6,447	
Rubbish Chute	\$78,000	0.58%	1	\$78,000	\$2,053	
Temporary Elevators	\$22,000	0.16%	1	\$22,000	\$579	
Rubbish Removal	\$300,000	2.23%			\$7,895	
Total	\$1,300,000	9.64%			\$34,211	
Site Office & Job Needs						
Temporary Office	\$200,000	1.48%	2	\$100,000	\$5,263	
Office Set Up	\$55,000	0.41%	2	\$27,500	\$1,447	
Field Office Furniture	\$40,000	0.30%	1	\$40,000	\$1,053	
Project Signs	\$5,000	0.04%			\$132	
Postage	\$35,000	0.26%			\$921	
Copier	\$35,000	0.26%	1	\$35,000	\$921	
Job Office Supplies	\$53,000	0.39%			\$1,395	
Travel	\$20,000	0.15%			\$526	
Vehicles	\$161,000	1.19%	5	\$32,200	\$4,237	
Telephone	\$13,500	0.10%	14	\$964	\$355	
Computer	\$23,000	0.17%	14	\$1,643	\$605	
Blueprints	\$55,000	0.41%			\$1,447	
Job Signs	\$5,000	0.04%			\$132	
Gross Receipts Tax	\$240,000	1.78%			\$6,316	
Closeout Submittals	\$35,000	0.26%			\$921	
Fill Pool	\$10,000	0.07%	1	\$10,000	\$263	
Total	\$985,500	7.31%			\$25,934	
Site Security						
Pest Control	\$2,500	0.02%			\$66	
Site Fence	\$11,500	0.09%			\$303	
Security	\$10,500	0.08%			\$276	
Watchman Services	\$280,000	2.08%			\$7,368	
Temporary Barriers & Enclosures	\$75,000	0.56%			\$1,974	
Safety Material	\$16,500	0.12%			\$434	
Temporary Protection	\$95,000	0.70%			\$2,500	
Total	\$491,000	3.64%			\$12,921	

Contracts					
Legal Services	\$10,000	0.07%			\$263
Miscellaneous Contracts	\$10,000	0.07%			\$263
Constructware	\$57,000	0.42%	1	\$57,000	\$1,500
Total	\$77,000	0.57%			\$2,026
Insurance					
Umbrella Liability Insurance	\$1,110,000	8.23%	1	\$1,110,000	\$29,211
General Liability Insurance	\$1,095,000	8.12%	1	\$1,095,000	\$28,816
Workers Compensation Insurance	\$1,350,000	10.01%	1	\$1,350,000	\$35,526
Total	\$3,555,000	26.37%			\$93,553
General Conditions Total	\$13,482,500				\$354,803